

CLAIMS

1. A lithographic projection apparatus comprising:
  - a radiation system to provide a projection beam of radiation;
  - 5        patterning structure, which can be used to pattern the projection beam according to a desired pattern;
  - a substrate table to hold a substrate; and
  - a vibrationally isolated portion of the apparatus silent world supported by a vibration isolation system and comprising a projection system for imaging the patterned
  - 10       beam onto a target portion of the substrate;
  - a detector to observe relative movement between a first and a second portion of said vibrationally isolated portion of the apparatus, and generating at least one movement signal representative thereof;
  - an actuator responsive to at least one control signal for exerting a force upon said
  - 15       vibrationally isolated portion of the apparatus; and
  - a controller responsive to said at least one movement signal to generate said at least one control signal to reduce relative movement between said first and said second portion.
- 20       2. A lithographic projection apparatus according to claim 1 wherein said actuator is constructed and arranged to exert a force upon the first or second portion.
3. A lithographic projection apparatus according to claim 1 wherein said actuator is constructed and arranged to exert said force by accelerating a reaction mass with respect
- 25       to a remaining portion of said vibrationally isolated portion of the apparatus.
- 4       A lithographic projection apparatus according to claim 3, wherein said detector detects relative displacement between said reaction mass and the remaining portion of the vibrationally isolated portion of the apparatus.
- 30       5. A lithographic projection apparatus according to claim 1, wherein said detector and said actuator are constructed and arranged to connect said first portion with said second portion.

6. A lithographic projection apparatus according to claim 5, wherein said first portion is the projection system and said second portion comprises a main plate for supporting the projection system.

5 7. A lithographic projection apparatus according to claim 6, wherein the detector detects relative tilt between said projection system and said main plate, said actuator is adapted to tilt said projection system relative to said main plate, and said controller generates said at least one control signal to reduce relative tilt between said projection system and said main plate.

10 8. A lithographic projection apparatus according to claim 1, wherein said first portion is the projection system and said second portion comprises a main plate for supporting the projection system.

15 9. A lithographic projection apparatus according to claim 6, wherein said detector detects relative displacement between said projection system and said main plate, and said actuator is for displacing said projection system relative to said main plate.

20 10. An apparatus according to claim 1, wherein said detector, actuator and controller are adapted to detect and reduce relative movements between portions of the vibrationally isolated portion of the apparatus having a frequency in the range 20-200 Hz.

25 11. An apparatus according to claim 1, wherein said detector, actuator and controller are tuned to compensate for movements of the projection system in a frequency band around its eigenfrequency

12. An apparatus according to claim 11, wherein said frequency band comprises frequencies within  $\pm 20$  Hz of the eigenfrequency.

30 13. An apparatus according to claim 1, wherein said detector and actuator comprise a plurality of parallel sets of piezoelectric sensor blocks connected in series with actuator blocks, said plurality of sets connecting said projection system to said main plate.

14. A device manufacturing method using a lithographic projection apparatus comprising:

projecting a patterned beam of radiation onto a target area of a layer of radiation-sensitive material on a substrate;

5 detecting relative movement between at least a first and a second portion of a vibrationally isolated portion of the apparatus comprising at least a portion of a projection system of the projection apparatus;

generating at least one movement signal representative of the detected relative movement;

10 exerting a force upon said vibrationally isolated portion of the apparatus responsive to said movement signal; and

generating said at least one control signal responsive to said movement signal, thereby to reduce relative movement between said first and said second portion of said vibrationally isolated portion of the apparatus.

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15. A device manufactured in accordance with the method of claim 14.